



# UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE  
United States Patent and Trademark Office  
Address: COMMISSIONER FOR PATENTS  
P.O. Box 1450  
Alexandria, Virginia 22313-1450  
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
-----------------	-------------	----------------------	---------------------	------------------

10/749,618

12/30/2003

Steven K. Reinhardt

42PI7412

8291

59796

7590

05/04/2007

INTEL CORPORATION  
c/o INTELLEVATE, LLC  
P.O. BOX 52050  
MINNEAPOLIS, MN 55402

EXAMINER

PARTRIDGE, WILLIAM B

ART UNIT

PAPER NUMBER

2183

MAIL DATE

DELIVERY MODE

05/04/2007

PAPER

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

<div style="border: 1px solid black; width: 150px; height: 20px; margin: 0 auto;"></div> <b>Office Action Summary</b>	<b>Application No.</b> 10/749,618	<b>Applicant(s)</b> REINHARDT ET AL.	
	<b>Examiner</b> William B. Partridge	<b>Art Unit</b> 2183	

**-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --**

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 30 December 2003.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-10 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-10 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 15 August 2006 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some \*    c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |   |   |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)   | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)  | 5) <input type="checkbox"/> Notice of Informal Patent Application                       |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)<br>Paper No(s)/Mail Date <u>14 July 2005</u> . | 6) <input type="checkbox"/> Other: _____  |

### **DETAILED ACTION**

Claims 1-10 are pending and have been examined.

#### ***Information Disclosure Statement***

1. The information disclosure statement (IDS) submitted on 7/14/2005 is in compliance with the provisions of 37 CFR 1.97. Accordingly, the information disclosure statement is being considered by the examiner.

#### ***Specification***

2. The disclosure is objected to because of the following informalities: The use of acronyms without first defining them, for example, SDC FIT, SRT, SMT, and RMT. An acronym must first be clearly defined before using it as the meaning of the acronym may change with time or depending on the context in which it is used.

Appropriate correction is required.

#### ***Claim Objections***

3. Claims 1-10 are objected to because of the following informalities:  
  
Claims 1-4 refer to instructions while Claims 5-10 refer to threads suggesting that there is difference between the two claim sets. It is unclear if this is intentional or in error. Examiner suggests amending Claims 1-4 to refer to threads in order to provide consistency across both claim sets.

Regarding Claim 1, "saving result" should be "saving a result" and "and result from" should be "and a result from" in order to improve the grammar of the claim. Further, "comparing the results saved in memory" should be "comparing the results saved in memory of both threads with each other" in order to improve clarity as it is unclear as to what is being compared. Further, "single set of instruction" should be changed to "single result" as the instruction is not what is committed, rather the result is. At the very least it should be "single set of instructionss" as a set requires more than one.

Regarding Claim 2, "saved result are" should be "saved resultss are".

Regarding Claim 5, "saving the executed threads" should be changed to "saving a result from each of the executed threads" as the results are what are saved and not the threads themselves. Further, "comparing the results saved in memory" should be "comparing the results saved in memory of both threads with each other" in order to improve clarity as it is unclear as to what is being compared. Further, "single set of thread" should be changed to "single result" as the thread is not what is committed, rather the result is. At the very least it should be "single set of threadss" as a set requires more than one.

Regarding Claim 7, "each epoch" should be "each epoch thread" in order to improve consistency across the claim set.

Regarding Claim 10, "single set" should be "single result". Further, "if the compare result matches" should be "if the compare result is a match" in order to improve clarity.

Appropriate correction is required.

### ***Double Patenting***

4. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory obviousness-type double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement.

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

5. Claims 1-2, 4-7, and 9-10 are provisionally rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1-3, 5-7, 9-10 of copending Application No. 10/750,039. Although the conflicting claims are not identical, they are not patentably distinct from each other because the deferment of external updates until completion is an obvious modification, in order to keep the cost of updating low, and as the system of the present application is intended to detect faults the values for each thread are inherently the same in order to be able to detect a fault.

This is a provisional obviousness-type double patenting rejection because the conflicting claims have not in fact been patented.

***Claim Rejections - 35 USC § 102***

6. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

7. Claims 1-10 are rejected under 35 U.S.C. 102(b) as being anticipated by Rotenberg (*"AR-SMT: A Microarchitectural Approach to Fault Tolerance in Microprocessors"*) herein referred to as Rotenberg.

Claim 1

Regarding Claim 1, Rotenberg teaches: **A method comprising:**  
**executing corresponding instruction threads in parallel as a leading thread and a trailing thread** (Figure 2, A-Stream and R-Stream, Section 1.2 *Note: The R-stream lags behind the A-stream and is therefore a trailing thread*); **saving result from the instruction executed in the leading thread and result from the instruction executed in the trailing thread to memory** (Figure 2, Delay Buffer, Section 1.2); **comparing the results saved in memory** (Section 1.2, Paragraph 2, "As the R-stream is fetched and executed, it's committed results are compared to those in the Delay Buffer" *Note: The results of the A-Stream are stored in the Delay Buffer for comparison*); **and committing a single set of instruction to a memory state based on the compared result** (Section 1.2,

Paragraph 2 *Note: If the comparison fails then a fault is detected and the results would not be committed as the actual result of the instruction given that the result is a known fault).*

#### Claim 2

Regarding Claim 2, the rejection of Claim 1 is incorporated and further Rotenberg teaches: **the saved result are saved as speculative** (Section 1.2 *Note: As the status of the results could still be a fault they are inherently speculative).*

#### Claim 3

Regarding Claim 3, the rejection of Claim 2 is incorporated and further Rotenberg teaches: **the executed instructions are buffered in the memory** (Figure 2, Delay Buffer).

#### Claim 4

Regarding Claim 4, the rejection of Claim 1 is incorporated and further Rotenberg teaches: **the instructions are epoch instructions** (Section 1.2 *Note: The system executes threads, a segment of a program, an epoch).*

#### Claims 5, 6, and 8-9

Regarding Claims 5, 6, 8, and 9, they are the apparatus claims corresponding to the method claims 1, 4, 3, and 2 respectively, and are rejected under the same reasons set forth in connection with the rejections of claims 1, 4, 3, and 2.

Claim 7

Regarding Claim 7, the rejection of Claim 6 is incorporated and further Rotenberg teaches: **each epoch is executed twice** (Section 1.2 Note: *As the thread is executed once in the A-stream and once in the R-stream it is executed twice*).

Claim 10

Regarding Claim 10, the rejection of Claim 9 is incorporated and further Rotenberg teaches: **the single set is committed if the compare result matches** (Section 1.2 Note: *If the compare fails (i.e. does not match) then a fault is detected, it stands that if a match occurs then the result is correct and therefore accepted as such*).

8. Claims 1-10 are rejected under 35 U.S.C. 102(b) as being anticipated by Reinhardt et al. ("Transient Fault Detection via Simultaneous Multithreading") herein referred to as Reinhardt.



Claim 1

Regarding Claim 1, Reinhardt teaches: **A method comprising:**  
**executing corresponding instruction threads in parallel as a leading thread**  
**and a trailing thread** (Figure 3, Thread 0 and Thread 1, Section 3.1 *Note: The*  
*redundant thread may be time redundant and is therefore a trailing thread*);  
**saving result from the instruction executed in the leading thread and result**  
**from the instruction executed in the trailing thread to memory** (Section 3.2,  
Paragraph 7, "register writeback comparison..." *Note: The results are stored in a*  
*register check buffer*) **comparing the results saved in memory** (Section 3.2,  
Paragraph 7, "register writeback comparison..." *Note: The values are compared*  
*and if they match then the value is committed*); **and committing a single set of**  
**instruction to a memory state based on the compared result** (Section 3.2,  
Paragraph 7, "register writeback comparison..." *Note: The values are compared*  
*and if they match then the value is committed*).

Claim 2

Regarding Claim 2, the rejection of Claim 1 is incorporated and further  
Reinhardt teaches: **the saved result are saved as speculative** (Section 3.2,  
Paragraph 7, "register writeback comparison..." *Note: As the instructions have*  
*yet to be committed they are still speculative*).

Claim 3

Art Unit: 2183

Regarding Claim 3, the rejection of Claim 2 is incorporated and further Reinhardt teaches: **the executed instructions are buffered in the memory** (Section 3.2, Paragraph 7, “register writeback comparison...”).

Claim 4

Regarding Claim 4, the rejection of Claim 1 is incorporated and further Reinhardt teaches: **the instructions are epoch instructions** (Section 3.1, *Note: The system executes threads, a segment of a program, an epoch*).

Claims 5, 6, and 8-9

Regarding Claims 5, 6, 8, and 9, they are the apparatus claims corresponding to the method claims 1, 4, 3, and 2 respectively, and are rejected under the same reasons set forth in connection with the rejections of claims 1, 4, 3, and 2.

Claim 7

Regarding Claim 7, the rejection of Claim 6 is incorporated and further Reinhardt teaches: **each epoch is executed twice** (Section 3.1, *Note: As the thread is duplicated into a redundant thread it is executed twice*).

Claim 10

Regarding Claim 10, the rejection of Claim 9 is incorporated and further Reinhardt teaches: **the single set is committed if the compare result matches** (Section 3.2, Paragraph 7, "register writeback comparison...").

### ***Conclusion***

9. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

"Transient-fault recovery using simultaneous multithreading" by Vijaykumar et al. teaches the use of simultaneous multithreading in order to prevent transient faults.

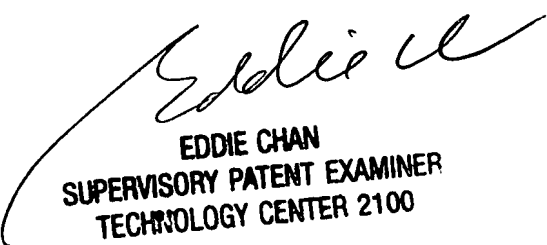
"Transient-fault recovery for chip multiprocessors" by Gomma et al. teaches the use of a multiprocessor system in order to recover from transient faults.

10. Any inquiry concerning this communication or earlier communications from the examiner should be directed to William B. Partridge whose telephone number is (571) 270-1402. The examiner can normally be reached on M-TR 7:00 - 5:30.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eddie Chan can be reached on (571) 272-4162. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Examiner: William B. Partridge  
Date: 4/19/2007



EDDIE CHAN  
SUPERVISORY PATENT EXAMINER  
TECHNOLOGY CENTER 2100